of streamers were 8.32, 8.40, and 8.43 p. m. At 8.48 the appearance was quite faint, and at 8.53 p. m. all had vanished except a hazy spot in the north-northwest. At 9.03 the arch of light again appeared fully as bright as before, but there were no streamers up to 9.20 p. m., when the observer ceased to watch the display. The most important point to be noted is the fact that the streamers started from below the arch; not only were they seen to start below the arch but their path across it was distinctly seen. This would seem to indicate that they were independent of the arch. The streamers seemed to converge to a point beneath the horizon.

Beverly, Burlington county, New Jersey: an aurora was visible from 7.30 to 9 p. m. of the 23d. It first appeared as a pink glow, afterwards as a low white arch. At 8.40 p. m. three narrow white streamers appeared. The arch disappeared at 8.50 p. m., leaving only a white glow in the northeast.

New York City: an aurora was seen at 8 p. m. of the 23d, illuminating the northern horizon. The light appeared in the shape of a well-defined arch, covering about 100° of azimuth. At times the light became quite brilliant, with streamers shooting upward and outward, giving the display the appearance of a blazing fan.

Bancroft, Kossuth county, Iowa: an auroral display commenced at 8.10 p. m. of the 23d and continued, with varying degrees of brightness, until 11 p. m. It consisted of a bright arch, with rapidly changing streamers darting from the upper surface.

Gardiner, Kennebec county, Maine: brilliant auroral streamers were seen flashing from above a dark cloud at 9 p. m. of the 23d. At 10 p. m. the streamers had coalesced and the display resembled moonlight.

Winnemucca, Nevada: a faint aurora was visible for about two hours during the evening of the 23d. It was first seen about 8 p. m. and disappeared at about 10 p. m. The light faded away so gradually that it was scarcely possible to note the exact minute of its disappearance. The display was brightest at a few minutes after 9 p. m., though at no time was it very brilliant. Its first appearance was in the form of a yellow glow in the northern horizon, which became more distinct as the twilight faded and the sky became darker. It then presented the appearance of an irregular arch of yellow light. At times a greenish tint could be observed near the upper edge of the arch. The azimuth of the western extremity was 155° and of the eastern 215°; altitude, 15°. The degree of brilliancy varied at times, but there were no flashes of light, nor any motion of the arch, except that in disappearing the size of the arch diminished, seeming to sink down and finally disappear below the horizon.

Duluth, Minnesota: an aurora was observed from 9.30 p. m. of the 23d until daylight of the 24th. The aurora as first seen consisted of pale yellow light extending from azimuth 95° to 260°. At 10.30 p. m. it had gradually assumed the form of an arch, which extended from azimuth 110° to 255°, with an altitude of 30°. Streamers appeared at 10.45 p. m., and continued to increase in size and number until 11.15, when the display was quite brilliant.

Fort Buford, Dakota: a fine auroral display commenced at 10.25 p. m. of the 23d. It first appeared as two brilliant white arches of light extending from northwest to east. The height of the upper arch was about 25°. The lower arch was bounded beneath by a very dark segment through which the stars were dimly seen. At 11 p. m. a third, and part of a fourth arch were formed, the fourth extending nearly to the zenith. At this time the eastern extremities of the arches began to break into yellow streamers which shot up like flames to a height of 30°. At 11.30 p. m. the western sides of the arches were perfect, while the eastern ends assumed the form of a large white curtain swayed by the wind. The display faded from view shortly before midnight.

La Crosse, Wisconsin: a red auroral light was noticed at 9.20 p. m. of the 23d in the northern sky. At 9.45 p. m. a pale white arch had formed. Shortly after 11 p. m. a second arch was seen, at an altitude of 50°, slowly advancing toward the zenith. The aurora disappeared at 11.47 p. m.

Auroral displays were also observed during the month, as follows:

2d.—Embarras, Wisconsin.

4th.—Vevay, Indiana; Parkersburg, West Virginia.

5th.—Vevay, Indiana.

7th.—Webster, Dakota; Poplar River, Montana.

11th.—Fort Totten, Dakota; Heath, Massachusetts; Egg Harbor City, New Jersey.

12th.—Eastport, Maine; Palermo, New York.

13th.—Fort Totten, Dakota; Mackinaw City, Michigan; Duluth, Minnesota.

14th.—Eastport, Maine; Mackinaw City, Michigan.

16th.—Westborough, Massachusetts.

17th.—Fort Totten, Dakota; Mackinaw City, Michigan; Newport, Vermont.

20th.—Orono, Maine; Berlin Mills, New Hampshire; Newport, Vermont.

21st.—Lunenburg, Vermont.

22d.—Block Island, Rhode Island.

23d.—New Haven, New London, Hartford, North Colebrook, and Southington, Connecticut; Webster and Fort Totten, Dakota; Riley, Illinois; Fort Madison, Independence, Manchester, and Monticello, Iowa; Allison, Kansas; Eastport, Portland, Bar Harbor, and Orono, Maine; Woodstock, Maryland; Blue Hill Observatory, Cambridge, Boston, Fall River, Milton, Princeton, Somerset, and Westborough, Massachusetts; Grand Haven, Mackinaw City, and Traverse City, Michigan; Moorhead, Minnesota; Poplar River, Montana; Valentine, Nebraska; Nashua, New Hampshire; Beverly, Clayton, Dover, Moorestown, and Upper Mountclair, New Jersey; Albany, Cooperstown, Factoryville, Mountainville, and Setauket, New York; Bethlehem, Catawissa, Dyberry, and Wellsborough, Pennsylvania; Variety Mills, Virginia; Fort Spokane, Washington Territory; Manitowoc and Prairie du Chien, Wisconsin.

24th.—New London, Connecticut; Lunenburg and Post Mills, Vermont.

25th.—Pekin, Illinois.

26th.—Pekin, Illinois; Atlantic City, New Jersey; Newport, Vermont.

27th.—Windsor, Illinois.

THUNDER-STORMS OF AUGUST, 1886.

[By Jr. Prof. H. A. HAZEN.]

During August there were received from voluntary observers 631 reports of distinct storms; from Signal Service observers 337; and from special thunder-storm observers 1,884, making a total of 2,852, or 470 more than during June, and 144 more than during July. The distribution by states and districts will be seen in the accompanying table. This table does not give an idea of the relative frequency in the different states, as some have many more observers than others, but it will serve for comparison with similar tables in previous months. The days of greatest number were 1st, 219; 11th, 203; 12th, 238; 13th, 273; and 16th, 298; and of least number, were 2d, 19; 3d, 12; 7th, 14; 19th, 17; 20th, 18; 24th, 6; 25th, 17; 26th, 13; and 31st, 18. It will be seen that there were two well-marked periods of thunder-storm activity, from the 11th to 17th, and from the 27th to 30th. On the 16th the conditions were specially interesting, it being the hottest day of the month, the temperature rising to 104° in the afternoon. On this date there were the most storms of any day, and some idea of the conditions on this date may be gleaned from chart ix. Most all the storms on this date occurred before noon, hence the map of isobars, isotherms, and wind-directions has been chosen for 7h.00. It will be seen that, as in the previous month, nearly every storm is in the southeast quadrant of the low area. This chart is specially interesting as showing the conditions ushering in the tornadoes of the afternoon of this date, elsewhere described in detail.

Thunder-storms by districts, August, 1886.

District.	State.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12	13.	14.	15.	16.	17	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	Total.
I	Connecticut														2															I		I	4
	Maine	I	I					I		I		3			I					I										I			10
	Massachusetts		I			I	I					3	7		12															2		2	29
	New Hampshire	2				I						2																				I	6
	New York	17	2									9		12	5		11													9	12	2	79
	Rhode Island								I						3																		4
	Vermont	4	2									7		I	5																		19
	Total	24	6			2	I	I	I	I		24	7	13	28		II			I									12	13	6	151
II	Delaware																																0
	Maryland	6					I							3				2										I	I		8		22
	New Jersey	3	2			2	I					4			5		2												I	5	2	I	28
	North Carolina		I				3					2	4	7	3	3		7	7	I						I	2	I	I	I			45
	Pennsylvania	10			I	3		2			I	I		5	2		3												I	2	5	2	38
	Virginia	7				2	6	5		2	I	I	7	8	6	I	I	9	4			I	I	I		3	I	2	6	6	7	I	89
	West Virginia																																
	Total	26	3		I	7	II	7		2	2	8	II	23	16	4	6	18	II	I	I	I	I	I		4	3	4	10	14	22	4	222
III	Illinois	9	I		I	6	10					10	21	18	4	13	8	9	8			2	3					2	12	19	I		157
	Indiana	II					12					8	18	18	8	5	24	II	2	I		2	18	2				3	14	19	I		177
	Kentucky						3						2	I	I	I		I	I				I			I			I	I			14
	Ohio	123	3		4	10	53	2	3	3	I	74	81	103	89	9	199	20			I	22	144	12		5	I	2	26	83	28	I	1,102
	Tennessee	5				I	5						4			5		7	4	2	2		7	9	6	I	2	8	7	6	4	I	86
	Total	148	4		5	17	83	2	3	3	I	92	126	140	102	33	231	48	15	3	3	26	173	23	6	7	3	15	60	128	34	2	1,536
IV	Michigan	3					I						3	10		3	7	2			2	14	3					4	9	8			69
	Minnesota					I			I	4	I	4	I	2		6				2	I	5						I	I				30
	Wisconsin	I			3	I	3					I	I	4		3	7				6	10	I					I	2	7	I			52
	Total	4			3	2	4		I	4	I	5	5	16		12	14	2		2	9	29	4					2	7	16	9			151
V	Dakota				3	2		2		4	3	I	4	2	5	6				I	I	I				3							38
	Iowa	10	I		10	34	6	I	22	II	17	67	79	70	25	46	20	18	2	7	3	10				I		20	40	7	I	I	541
	Nebraska	I	3	I	I	3		I	3	6	5	3	3	6	I	I	3	3		I		I						I	I				48
	Total	II	4	I	14	39	6	4	25	21	25	71	86	78	31	53	29	21	2	9	4	18				4		21	41	7	I	I	627
VI	Arkansas	2		I			I					I	I															2	2	2			12
	Indian Territory				I	I				I										I		I				I		I					7
	Kansas	2	2	7	2	12			6	7	10	2		I	4	I	3	4			I		I	5	12	6	3				5	97
	Missouri	2		3	I	2					7		3	2	I	3	4	8	2				2					5	2	2			49
	Total	6	2	II	4	15	I		6	8	18	3	3	3	5	4	7	12	2	I	I	I	3			2	5	20	10	7		5	165
	Grand total	219	19	12	27	82	103	14	36	39	47	203	238	273	182	106	298	101	30	17	18	75	181	24	6	17	13	67	137	177	70	18	2,852

CHART OF ELECTROMETER READINGS.

[By Prof. T. C. MENDENHALL, Assistant.]

Observations have been made during the month of August, as usual, at all stations.

At Boston, Massachusetts, negative indications occurred on the following dates: 1st, 3d, 4th, 5th, 9th, 12th, 14th, 16th, 25th, and 30th. Rain occurred during night of 1st; afternoon of 3d; during night of 5th; during night of 7th; during afternoon of 12th; morning of 14th; and afternoon of 30th. The morning of the 25th was cloudy and threatening. The only date during the month on which rainfall was not accompanied or preceded by negative indications was August 7th. This was a foggy and damp day with fresh east winds, and was characterized by unusually high positive potentials.

At Ithaca, New York (Cornell University), negative values occurred on the 1st during thunder-storm; on the 3d, following rain; on the 2d; on the 5th, preceding rain several hours; on the 7th, following rain; on 16th, preceding rain; and on 17th, unaccompanied by rain. A very severe thunder-storm occurred on the evening of the 11th, not preceded by any unusual indication. A severe thunder-storm occurred on the 16th in which the indications were throughout positive, ranging from 152 to 2,625 volts.

The first diagram of chart vi represents a series of mean values for that part of the day between 9 a. m. and 3 p. m., obtained in the following way: All dates of thunder-storms and abnormal variations are omitted in this discussion of mean values, as it is evident that the great values obtained at these times would either masque or distort the diurnal variation due to more regular causes. Groups of five days are taken, and the mean of each of the four daily observations determined. This, in the case of Washington City, is represented by the line numbered 1; the mean observations made on June 29th, 30th, July 3d, 4th, and 5th; intervening dates being omitted for the reasons above stated. The mean values for the 9 and 11 a. m., 1 p. m., 3 p. m. observations were, 138, 126, 138, and 114 volts, respectively. Similarly for the 6th, 7th, 8th, 10th, and 16th, the curve numbered 2 represents the mean values 92, 95, 100, and 91 volts. For the 17th, 18th, 20th, 22d, and 24th, curve numbered 3 represents 75, 91, 102, and 109 volts; and for the 26th, 27th, 28th, and August 4th and 5th, curve numbered 4 represents 78, 90, 99.6, and 107 volts. The mean of these values, in turn, is represented by the dark-lined curve numbered 5. The values are 76.6, 80.4, 85.0, and 84.0; or, for this time and locality, the curve seems to show a steady rise during the forenoon, reaching a maximum about the early part of the afternoon.

The second diagram on chart vi. represents a like determintion for Boston, Massachusetts. Observations are made here at the Massachusetts Institute of Technology, and for many reasons we ought not anticipate any striking correspondence. Curve number 1 represents the mean of the observations made on June 29–30th, July 1st, 2d, 3d, giving as values—minus 8.9, minus 11.9, minus 7.6, and plus 18.3. From the 4th to the 8th, inclusive, the values are throughout on the negative side, 13.7, 12.8, 16.9, and 15.4. From the 9th to 13th, inclusive, the values are positive, 9.6, 7.8, 6.3, and 6.2, represented by curve numbered 3. Curve numbered 4 gives the values from the 14th to the 18th, inclusive, viz., 5, 10, 26.2, 14.2; curve numbered 5, the values from the 18th to the 23d, 65.5, 90.7, 128.2, and 125.1, and curve numbered 6, the values of the 24th, 25th, 26th, 27th, and 29th, minus 1.3; plus 43.8, 44.5, 54.3. The mean for the month is represented by the curve numbered 7, representing the following mean values for the four observations at 9 and 11 a. m. and 1 and 3 p. m., 9.4, 21.3, 29.6, 33.8, respectively.

The third portion of the first diagram of chart vi gives the values, obtained in the same way, for New Haven, Connecticut. From June 24–29th, the mean values are 9.4, 8.2, 9.0, and 8.6; from June 30th to July 5th, 11.6, 15.8, 8.6, 8.8; from July 6th to 10th, represented by curve numbered 3, 9.4, 15.4, 8.6, 9.0, from July 12th to 17th, represented by curve numbered 4, 12.0, 7.0, 5.8, 12.0, and from 19th to 24th, omitting the 21st,